RECONFIGURABLE ANTENNAS UTILIZING PARASITIC PIXEL LAYERS

RELATED APPLICATIONS

This application claims priority under 35 U.S.C. §119(e) to U.S. Provisional Patent Application No. 61/584,546, filed Jan. 9, 2012, and entitled "RECONFIGURABLE ANTENNAS UTILIZING A PARASITIC LAYER," which is incorporated herein by reference in its entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

The technology described in this application was developed at least in part by Award No. 2007-IJCX-K025 and Award No. 2009-SQ-B9-K005, awarded by the National Institute of Justice, Office of Justice Programs, United States Department of Justice. The U.S. government has certain rights in the invention.

TECHNICAL FIELD

This disclosure relates generally to reconfigurable antennas. More specifically, but not exclusively, this disclosure relates to reconfigurable antenna designs utilizing parasitic layers.

SUMMARY

The present disclosure in aspects and embodiments describes a reconfigurable antenna that includes an active driven antenna element and a parasitic element disposed over the active antenna element, the parasitic element including an array of selectively reconfigurable pixels. In embodiments, a geometry of the array is reconfigurable; the parasitic element may further include a network of microelectromechanical switches configured to selectively reconfigure the array of selectively reconfigurable pixels based on control voltages.

The reconfigurable antenna may be configured to operate at frequencies between 4 GHz and 6 GHz. In embodiments, the reconfigurable antenna further includes highly resistive bias lines configured to drive one or more microelectromechanical switches of the network of microelectromechanical switches by the control voltages.

In embodiments, the array of selectively reconfigurable pixels may be arranged in a grid pattern. The reconfigurable antenna may be configured to operate in a plurality of operating modes, each operating mode corresponding to a particular configuration of the array of selectively reconfigurable pixels.

The reconfigurable antenna may be configured to operate at a plurality of beam steering angles based at least in part on the configuration of the array of selectively reconfigurable pixels. In embodiments, the plurality of beam steering angles include at least one of beam steering angle between θ_i=−60° and 60°. The reconfigurable antenna may be configured to operate at a Linear, Circular, or Elliptical polarization based at least in part on the array of selectively reconfigurable pixels.

The reconfigurable antenna may include a plurality of antenna array elements, each antenna array element including at least one of the active driven antenna element and the parasitic element.

The disclosure further describes a reconfigurable antenna that includes a plurality of antenna array elements, each antenna array element containing an active driven antenna element and a parasitic element disposed over the active antenna element, the parasitic element comprising an array of selectively reconfigurable pixels configured to couple with electromagnetic energy emitted from the active antenna element via electromagnetic mutual coupling.

In embodiments, the antenna array elements are arranged in a linear array configuration; the reconfigurable antenna may be configured to operate at frequencies between 4 GHz and 6 GHz.

The reconfigurable antenna may further include an aperture coupled feed line configured to feed the active driven antenna element and the array of selectively reconfigurable pixels may be arranged in a grid pattern and a foam substrate may be configured to separate the parasitic element from the active driven antenna element.

In embodiments, the reconfigurable antenna may be configured to operate at a plurality of beam steering angles based at least in part on the configuration of the array of selectively reconfigurable pixels. The plurality of beam steering angles may include at least one of beam steering angle between θ_i=−60° and 60°.

In other embodiments, the reconfigurable antenna may be configured to operate at a Linear, Circular, or Elliptical polarization based at least in part on the configuration of the parasitic element.

The present disclosure also describes a method for determining a configuration for reconfigurable antenna having one or more desired operational modes using a combinatorial optimization performed by a computer system including a processor and a non-transitory computer-readable medium storing instructions that, when executed by the processor, cause the processor to store a representation of a chromosome structure of a parasitic pixel surface of the reconfigurable antenna; determine one or more objective functions for the one or more desired operational modes; define one or more optimization problems based on the representation and the one or more objective functions; determine one or more iterative solutions to the one or more optimization problems; and determine a configuration for the parasitic pixel surface based on a terminal solution of the one or more iterative solutions.

BRIEF DESCRIPTION OF THE DRAWINGS

Non-limiting and non-exhausting embodiments of the disclosure are described, including various embodiments of the disclosure with reference to the figures, in which:

FIG. **1** illustrates an exploded view of a reconfigurable antenna;

FIG. **2** illustrates a microelectromechanical system (MEMS) switch used in actuating a parasitic pixel array;

FIG. **3** illustrates an exemplary reconfigurable parasitic pixel surface;

FIG. **4** illustrates a flow chart of a method for implementing a non-dominated sorting genetic algorithm (NSGA);

FIG. **5** illustrates a binary and real value representation of the chromosome structure of an exemplary reconfigurable parasitic pixel surface;

FIGS. **6**A-**6**C illustrate exemplary objectives for an optimization problem;

FIG. **7** illustrates geometries of a reconfigurable parasitic pixel surface under six exemplary operating modes;

FIG. **8** illustrates an exploded view of another reconfigurable antenna;

FIG. **9** illustrates a cross section view of a reconfigurable antenna;

FIG. **10** illustrates exemplary beam steering capabilities of a reconfigurable antenna;